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Annex A: Ancient Civilizations Analysis under the Human Equilibrium Index (HEI / IEH)

This annex restores and systematizes the historical-civilizational analysis as a qualitative validation layer for the Human Equilibrium Index. It maps major patterns of decline across selected civilizations onto the HEI components: family capacity (α_1), social embeddedness (α_2), structural strength (F), social energy (S), balance (B), and adaptability (D). The aim is not to claim precise retrospective measurement, but to show that the model’s logic is historically plausible across cases of large-scale civilizational stress and collapse.[cite:48][cite:54][cite:62]

Methodological note

For each civilization, principal causes of decline were identified from historical syntheses and then mapped to HEI components. The mapping follows the same logic used in the contemporary version of the model: (α_1) captures family-level material and caregiving stability, (α_2) captures cohesion and community embeddedness, (F) captures institutional and infrastructural strength, (S) is the average social state, (B) penalizes large asymmetries between (α_1) and (α_2), and (D) reflects adaptive capacity under sustained stress.[cite:48][cite:54][cite:57]

1. Western Roman Empire

The decline of the Western Roman Empire is commonly associated with a combination of barbarian invasions, military deterioration, political instability, domestic quarrels, and, in some interpretations, climatic deterioration and epidemic stress.[cite:48][cite:49][cite:51]

- α_1 **Family capacity:** economic disruption, tax burdens, declining agricultural productivity, and insecurity likely reduced household stability and livelihood security.[cite:48][cite:49]
- α_2 **Social embeddedness:** political fragmentation, weakened civic trust, and internal disorder undermined social cohesion and collective attachment to imperial institutions.[cite:48][cite:49]
- **F Structural strength:** military weakening, administrative fragmentation, and declining fiscal capacity reduced the institutional strength of the empire.[cite:48][cite:49]

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- **B Balance:** strong regional inequalities and differentiated collapse dynamics across provinces plausibly increased asymmetries between household resilience and social order, implying a lower B.[cite:48][cite:49]
- **D Adaptability:** responses to invasions and internal decline were often delayed, fragmented, or insufficient, indicating weak adaptive capacity.[cite:49][cite:51]

Interpretation: Rome illustrates a classic HEI decline pattern in which external shocks interacted with institutional weakening and internal fragmentation, jointly reducing S and F while increasing the penalty associated with imbalance.[cite:48][cite:49]

2. Han Dynasty

The end of the Han dynasty is generally linked to court corruption, eunuch domination, land inequality, peasant unrest, Yellow Turban rebellion, regional warlords, natural disasters, and eventual political fragmentation.[cite:53][cite:56][cite:62]

- α_1 : tax pressure, land concentration, famine, and agrarian crisis weakened the material stability of households.[cite:53][cite:56]
- α_2 : rebellion, violence, and declining legitimacy eroded community integration and trust in the imperial center.[cite:56][cite:62]
- **F:** the growing autonomy of regional warlords and the weakening of central authority sharply reduced institutional coherence.[cite:53][cite:62]
- **B:** inequalities between core and peripheral areas, and between elites and peasants, likely produced strong imbalances between family stability and social integration.[cite:53][cite:56]
- **D:** the Han state failed to adapt effectively to natural disasters, rebellion, and court capture, indicating low adaptability.[cite:56][cite:62]

Interpretation: The Han case strongly supports the HEI framework because it shows how agrarian decline, governance failure, and fragmentation can jointly depress (α_1), (α_2), F, and D.[cite:53][cite:62]

3. Classic Maya Civilization

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The Classic Maya collapse is widely interpreted as the result of interacting factors including prolonged drought, warfare, social disorder, overpopulation, and the breakdown of elite systems and trade networks.[cite:54][cite:57][cite:60]

- α_1 : drought and agricultural decline reduced food security and household survival capacity.[cite:54][cite:57]
- α_2 : warfare, migration, and social dislocation undermined community participation and cohesion.[cite:54][cite:60]
- **F**: elite political systems and water-management capacities weakened under prolonged stress, reducing institutional strength.[cite:54][cite:57]
- **B**: local differences in ecological stress and conflict intensity likely created significant asymmetries across Maya polities, implying balance penalties.[cite:54][cite:57]
- **D**: the inability to absorb climatic stress and reorganize effectively suggests low adaptability over time.[cite:57][cite:60]

Interpretation: The Maya case is especially valuable for HEI because it demonstrates how environmental shocks interact with institutional fragility and social breakdown to produce a sustained equilibrium collapse.[cite:54][cite:57]

4. Comparative synthesis

Across Rome, Han China, and the Classic Maya world, a common pattern emerges: civilizational decline tends to occur when external or structural shocks coincide with weakening institutions, household stress, and deteriorating cohesion.[cite:48][cite:54][cite:62] In HEI terms, this corresponds to falling (α_1), falling (α_2), lower F, and weak D, often accompanied by a lower B when social and household conditions become unevenly distributed across territories or groups.[cite:48][cite:57][cite:62]

5. Comparative table

Civilization	Main decline drivers	HEI components most affected	HEI interpretation

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Western Roman Empire	Invasions, political instability, military weakening, fiscal stress, possible climate and epidemic effects [cite:48][cite:49][cite:51]	$(\alpha_1), (\alpha_2), F, D, B$ [cite:48][cite:49]	Collapse resulted from interaction between external shocks and institutional fragmentation, reducing resilience and cohesion. [cite:48][cite:49]
Han Dynasty	Court corruption, peasant unrest, inequality, natural disasters, warlords, fragmentation [cite:53][cite:56][cite:62]	$(\alpha_1), (\alpha_2), F, D, B$ [cite:53][cite:62]	Agrarian distress and loss of central authority weakened both family stability and systemic coordination. [cite:53][cite:56]
Classic Maya	Drought, warfare, overpopulation, social disorder, elite-system breakdown [cite:54][cite:57][cite:60]	$(\alpha_1), (\alpha_2), F, D, B$ [cite:54][cite:57]	Prolonged ecological stress interacted with political and social disintegration, driving a persistent equilibrium decline. [cite:54][cite:57]

6. Annex conclusion

This historical annex does not provide direct quantitative validation, but it strengthens the conceptual and causal plausibility of HEI by showing that very different civilizational collapses can be interpreted through the same multi-component structure.[cite:48][cite:54][cite:62] The repeated association of household stress, weakened cohesion, declining institutional strength, and low adaptability suggests that the model captures a recurrent logic of systemic breakdown rather than a narrowly contemporary phenomenon.[cite:49][cite:57][cite:62]

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